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Optical and radio variability of BL Lacertae

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Abstract

© ESO, 2015. Context. We extensively observed the prototype blazar, BL Lacertae, in optical and radio bands during an active phase in the period 2010-2013 when the source showed several prominent outbursts. We searched for possible correlations and time lags between the optical and radio band flux variations using multi-frequency data to learn about the mechanisms producing variability. Aims. During an active phase of BL Lacertae, we searched for possible correlations and time lags between multi-frequency light curves of several optical and radio bands. We tried to estimate any possible variability timescales and inter-band lags in these bands. Methods. We performed optical observations in B, V, R, and I-bands from seven telescopes in Bulgaria, Georgia, Greece, and India and obtained radio data at 36.8, 22.2, 14.5, 8, and 4.8 GHz frequencies from three telescopes in Crimea, Finland, and USA. Results. Significant cross-correlations between optical and radio bands are found in our observations with a delay of cm-fluxes with respect to optical bands of ~250 days. The optical and radio light curves do not show any significant timescales of variability. BL Lacertae showed many optical "mini-flares" on short timescales. Variations on longer term timescales are mildly chromatic with the superposition of many strong optical outbursts. In radio bands, the amplitude of variability is frequency dependent. Flux variations at higher radio frequencies lead the lower frequencies by days or weeks. Conclusions. The optical variations are consistent with being dominated by a geometric scenario where a region of emitting plasma moves along a helical path in a relativistic jet. The frequency dependence of the variability amplitude supports an origin of the observed variations intrinsic to the source.

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Keywords

BL Lacertae objects: general, BL Lacertae objects: individual: BL Lacertae, Galaxies: active, Galaxies: jets, Quasars: general